



## Recent Advances in Science in Western Australia

### Earth Sciences

Strike-slip faulting, previously thought to be of minor importance, is shown by R Iasky, of the Geological Survey of WA, to have had a major impact on the evolution of the southern Perth Basin. Three major periods of tectonism re-activated major faults: right-lateral strike-slip motion along the Darling Fault in the Late Permian-Triassic led to the rise of the Harvey Ridge; tectonism with associated left-lateral strike-slip motion along the Dunsborough Fault in the Jurassic resulted in deposition and faulting; separation of Australia from India in the Early Cretaceous resulted in uplift with a predominantly tensional, but also some oblique-transcurrent, right-lateral, faulting.

Iasky R P 1993 A structural study of the southern Perth basin. Geological Survey of Western Australia. Report 31.

Archaean mafic and ultramafic volcanic rocks between Menzies and Norseman, which include massive and pillowed basalts and a komatiite unit, are grouped geochemically by P Morris, of the Geological Survey of WA, into a lower and an upper basalt group. The rocks were erupted subaqueously in deep water, probably in an elongate rift near an active arc.

Morris P A 1993 Archaean mafic and ultramafic volcanic rocks, Menzies to Norseman, Western Australia. Geological Survey of Western Australia. Report 36.

R Horwitz and E Ramanaidou, of the CSIRO Division of Exploration Geoscience, describe how a hiatus in parts of the Jeerinah Formation in the Hardey Syncline region was probably caused by submarine slumping during sedimentation. Removal by slumping, and redeposition westwards, could account forolistostromes previously recorded in the Jeerinah Formation on the southern rim of the Wyloo Dome.

Horwitz R C & Ramanaidou E R Slumping in the Marra Mamba Supersequence Package in the Southern Hamersley Province, Western Australia. Australian Journal of Earth Sciences 40:339-344.

Researchers from Curtin University and the Geological Survey of WA have measured Rb-Sr dates of 430-500 Ma for biotites in granite and gneiss in a 30-55 km wide belt at the western edge of the Yilgarn Craton, between Perth and Harvey. A transition zone 15-40 km wide separates this belt from an eastern chronological plateau where biotite dates are 2300-2600 Ma (marginally younger than whole-rock dates which average 2550 Ma and persist to the western edge of the craton). The 430-500 Ma dates probably represent resetting during uplift in the Early Palaeozoic.

De Laeter J R & Libby W G 1993 Early Palaeozoic Rb-Sr dates in the Yilgarn Craton near Harvey, Western Australia. Australian Journal of Earth Sciences 40:445-453.

Researchers based in Canberra (AGSO and ANU) describe how the Canning Basin contains several Zn-Pb sulphide prospects and deposits in Devonian reef complexes on the Lennard Shelf and in Ordovician and Silurian marine sequences on the northern margin of the Willara Sub-basin. The basin contains highly saline waters whose dominant component is bittern water probably expelled from marine evaporites in the Silurian Carribuddy Formation. These

bitterns are similar in chemical composition to metal-rich bitterns from the Mississippi Salt Dome Basin, and it is assumed that the Canning Basin bitterns were metalliferous and a component of the ore-forming fluids.

Ferguson J, Etminan H & Ghassemi F 1993 Geochemistry of deep formation waters in the Canning Basin, Western Australia, and their relationship to Zn-Pb mineralization. Australian Journal of Earth Sciences 40:471-483.

U-Th-Pb dating of zircons from Late Archaean granites in the Norseman region shows the existence of two distinct magmatic episodes, suggesting two periods of regional metamorphism at about 2660 and 2685 Ma. Large regional tonalitic and granodiorite plutons were emplaced between 2685 and 2690 Ma, while large regional granite and small tonalite and leucogranite plutons that intrude greenstones are 2660-2665 Ma.

Hill R I & Campbell I H 1993 Age of granite emplacement in the Norseman region of Western Australia. Australian Journal of Earth Sciences 40:559-574.

J Clarke, of the Western Mining Corporation, describes how the Lefroy and Cowan palaeodrainage systems were probably initiated in the pre-Jurassic, and both flowed to the north and east. The Cowan system reversed prior to Jurassic deposition in the Bremer Basin, to flow south to the Bremer Basin and the Lefroy palaeodrainage flowed east to the Eucla Basin. The first drainage channel fill occurred during the Eocene under fluvial to marine conditions. In post-Eocene times, the drainage channels fragmented into a series of lakes. From the Pliocene onwards, increasing aridity led to the deposition of gypsum in both Lake Cowan and Lake Lefroy.

Clarke J D A 1994 Evolution of the Lefroy and Cowan palaeodrainage channels, Western Australia. Australian Journal of Earth Sciences 41:55-68.

### Life Sciences

Patterns amongst Australian mammals and lizards of termite eating were examined by M Abensperg-Traun, of the Division of Wildlife and Ecology, CSIRO, Midland. In the arid and semi-arid zones, most termite consumers are lizards; dasyurid marsupials consume relatively few termites (<10% of their diet). It is argued that the low and variable rainfall of inland Australia results in seasonality of termite abundance, and so the specialized termite eaters are energy-frugal lizards.

Abensperg-Traun M 1994 The influence of climate on patterns of termite eating in Australian mammals and lizards. Australian Journal of Ecology 19:65-71.

Experimental studies of *Eucalyptus marginata* seed dispersal and mortality, by G Stoneman and B Dell of Murdoch University, and N Turner of the CSIRO Division of Plant Industry, indicated that small vertebrates substantially reduce emergence, whereas invertebrates only slightly reduce emergence. Seed removal was insignificant when covered by soil, or with an understorey and litter present to make the



seed less visible. Seed mortality was lower for sites with the overstorey removed or a greatly disturbed seedbed. Most mortality was due to water deficit in late spring and summer, and some was due to pathogenic fungi.

Stoneman G L & Dell B 1994 Emergence of *Eucalyptus marginata* (jarrah) from seed in Mediterranean-climate forest in response to overstorey, site, seedbed and seed harvesting. *Australian Journal of Ecology* 19:96-102.

Stoneman G L, Dell B & Turner N C 1994 Mortality of *Eucalyptus marginata* (jarrah) seedlings in Mediterranean-climate forest in response to overstorey, site, seedbed, fertilizer application and grazing. *Australian Journal of Ecology* 19:103-109.

Surveys of the burrowing bettong (*Bettongia lesueur*) by J Short and B Turner, of the CSIRO Division of Wildlife and Ecology, Midland, on Bernier, Dorre, Barrow and Boodie Islands of Western Australia, confirmed their being widespread and abundant on the first three islands, but not on Boodie Island. The burrowing bettong has been extinct on the mainland since the early 1960's, and is now restricted to <0.01% of its formerly natural range.

Short J & Turner B 1993 The distribution and abundance of the burrowing bettong (Marsupialia: Macropodoidea). *Wildlife Research* 20:525-534.

The diet of the noisy scrub-bird, a small, semi-flightless inhabitant of scrub and forest on the south coast of Western Australia, is described by A Danks (CALM, Two Peoples Bay Nature Reserve) and M Calver (Murdoch University). Adults and nestlings eat similar prey, but in differing proportions. Adults take mainly ants, beetles and spiders, whereas nestlings consume mainly spiders and crickets. It might be unrewarding for adults to transport small prey (ants), or heavily sclerotised prey (beetles), to the nestlings.

Danks A & Calver M C 1993 Diet of the noisy scrub-bird *Atrichornis clamosus* at Two Peoples Bay, South-western Western Australia. *Emu* 93:203-206.

The history, distribution, present status, breeding, sociality, demography and management of the two subspecies of purple-crowned fairy-wren is described by I Rowley and E Russell (CSIRO Division of Wildlife and Ecology, Midland). These birds occupy very restricted riverine vegetation across the Wet-Dry tropics of northern Australia, between the 400 and 1000 mm isohyets. The less numerous Kimberleyan subspecies is separated from the more abundant Carpentarian subspecies by 200 km of unsuitable habitat. The territorial birds breed mainly in the dry season (March-September), in large nests usually located at the base of a *Pandanus aquaticus* leaf. Annual productivity from the clutch of 2-3 is about 1 yearling per group of parents and associated mature progeny that cooperatively raise the young.

Rowley I 1993 The purple-crowned fairy-wren *Malurus coronatus*. I. History, distribution and present status. *Emu* 93:220-234.

Rowley I & Russell E 1993 The purple-crowned fairy-wren *Malurus coronatus*. II. Breeding biology, social organisation, demography and management. *Emu* 93:235-250.

*Hakea trifurcata*, a dimorphic species of Proteaceae, has two distinct leaf types (needle and broad), unlike other *Hakea*. The broad leaves, which superficially resemble the fruits and are located near them, are produced only by mature plants. Feeding trials by P Groom, B Lamont and H Duff, of Murdoch University, showed that the white-tailed black cockatoo

removed fewer fruits when broad leaves were present, indicating an unusual case of 'self-crypsis' wherein fruits mimicked the unrewarding broad leaves.

Groom P K, Lamont B B & Duff H C 1994 Self-crypsis in *Hakea trifurcata* as an avian granivore deterrent. *Functional Ecology* 8:110-117.

Detailed information on the diet type and size of the Arafura filesnake, based on a 4-year field study, enabled D Houston and R Shine, of Sydney University, to demonstrate seasonal variation in diet that was also related to the size and sex of the filesnakes. Female snakes generally fed on a single, large prey whereas males consumed numerous, smaller prey.

Houston D & Shine R 1993 Sexual dimorphism and niche divergence: Feeding habits of the Arafura filesnake. *Journal of Animal Ecology* 62:737-748.

A cooperative research study by researchers from the Agriculture Protection Board and Department of Agriculture, investigated the mobility of red kangaroos in arid Western Australia. The versatility in home range size, mobility, and dispersal of red kangaroos defies the conventional definitions of 'home range', and indicates the importance of irregular and temporary environmental dispersal in the behavioural repertoires of this species.

Norbury G L, Norbury D C & Oliver A J 1994 Facultative behaviour in unpredictable environments: Mobility of red kangaroos in arid Western Australia. *Journal of Animal Ecology* 63:410-418.

An interdisciplinary study by zoologists from the University of Western Australia and chemists from Murdoch University examined the role of urea and methylamines (TMAO, betaine, sarcosine) to the buoyancy of three western Australian elasmobranchs (whiskery shark, whaler shark and shovel-nosed ray). Particularly urea and TMAO contribute significant positive buoyancy, and this must be considered as an additional adaptive advantage to the well-accepted roles of urea and TMAO as balancing osmolytes, and TMAO as a counteracting solute.

Withers P C, Morrison G, Hefter G H & Pang T.-S. 1994 Role of urea and methylamines in buoyancy of elasmobranchs. *Journal of Experimental Biology* 188:175-189.

The hypothesis that predation rate by snakes may select for nest spacing and winter breeding in New Holland honeyeaters was tested by researchers from the Australian Museum. Results supported the notion that clumped nests experienced greater predation by birds, but not that winter breeding may have evolved as a strategy to avoid predation by snakes.

Major R E, Pyke G H, Christy M T, Gowing & Hill R S 1994 Can nest predation explain the timing of the breeding season and the pattern of nest dispersion of New Holland honeyeaters? *Oikos* 69:364-372.

## Physical Sciences

Researchers from Murdoch University have shown using Mössbauer spectroscopy that nanoscale iron oxide particles inside the protein ferritin can be converted by treatment with hydrogen sulphide gas to a layered structure of iron oxide and iron sulphide within the protein shell. Coagulation of these particles is prevented by the hydrophobic protein casing.

St. Pierre T G, Chua-anusorn W, Sipos P, Kron I & Webb J 1993 Reaction of hydrogen sulphide with native horse spleen ferritin. *Inorganic Chemistry* 32:4480-4482.

Polarised neutron diffraction experiments by B Figgis and P Reynolds, of the University of Western Australia, and J Cable, of Oak Ridge National Laboratory, USA, show that the bonding between technetium and chlorine in the ion  $TcNCl_4^-$  is highly covalent. Their measurements demonstrate the covalence of transition-ligand bonds in a more direct way than previously possible.

Figgis B N, Reynolds P A & Cable J W 1993 Extreme covalence in the Tc-Cl bond from polarized neutron diffraction. *Journal of Chemical Physics* 98:7743-7745.

Physicists at the University of Western Australia have used a polarised photon coincidence experiment to study the state multipoles and the partial cross sections for the excitation of helium atoms by an electron beam. Their results provide stringent tests for existing theories of collision processes, which are shown to be only in qualitative agreement with the experimental data.

Mikosza A G, Hippler R, Wang J B & Williams J F 1993 Determination of rank 4 multipoles and of partial cross sections for the  $He(3^1D)$  excitation by electron impact. *Physical Review Letters* 71:235-238.

Quantum mechanical calculations employing silane ( $Si_xH_y$ ) molecules have been used by scientists at Murdoch University to model the electronic structure of hydrogenated amorphous silicon. Calculations of the valence band density of states were in excellent agreement with experimental Auger electron spectra. The results obtained confirm that disorder in silicon lattices increases the defect states in the valence band and that hydrogenation ties off the dan-

gling bonds associated with the photodegradation of amorphous silicon.

Lund C P, Clare B W, Jennings P J, Cornish J C L & Hefter G T 1994 An experimental and theoretical study of Auger lineshapes in hydrogenated amorphous silicon structures. *Surface Science* 303:266-276.

*Note from the Hon Editor:* This column helps to link the various disciplines and inform others of the broad spectrum of achievements of WA scientists (or others writing about WA). Contributions to "Recent Advances in Science in Western Australia" are welcome, and may include papers that have caught your attention or that you believe may interest other scientists in Western Australia and abroad. They are usually papers refereed journals, or books, chapters and reviews. Abstracts from conference proceedings will not be accepted. Please submit short (2-3 sentence) summaries of recent papers, together with a copy of the title, abstract and authors' names and addresses, to the Hon Editor or a member of the Publications Committee: Dr S D Hopper (Life Sciences), Dr A E Cockbain (Earth Sciences), and Assoc Prof G Hefter (Physical Sciences). Final choice of articles is at the discretion of the Hon Editor.

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